Update on Beam Quality Parameters

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Beam Working Group Meeting
NOνA Collaboration Meeting
Fermilab
October 23, 2014

Outline

- Presentation of beam quality parameters for the period July 25, 2014 to September 5, 2014

- Proposal to change the delta t cut

- Distribution of POT-weighted horn current

- Plans for putting beam quality data into Nearline

Beam Quality Parameters

- deltaspilltimensec ($\Delta t < 1 \times 10^9$ nsec)

  Difference between event time and closest IFDB time (event time - IFDB time), can be + or -.

- spillpot (POT > 0.50×10^{12})

  First non-negative toroid value from the following devices in this order: TRTGTD, TOR101D. If both values are negative, indicating that the beam was off, then a value of "0" is assumed.

- hornI (-205 kA < horn current < -195 kA)

  Horn current is calculated using a sum of 4 device values, appropriately shifted and normalized (NSLINA, NSLINB, NSLINC and NSLIND).

- posx and posy (0.02 mm < pos x(y) < 2.00 mm)

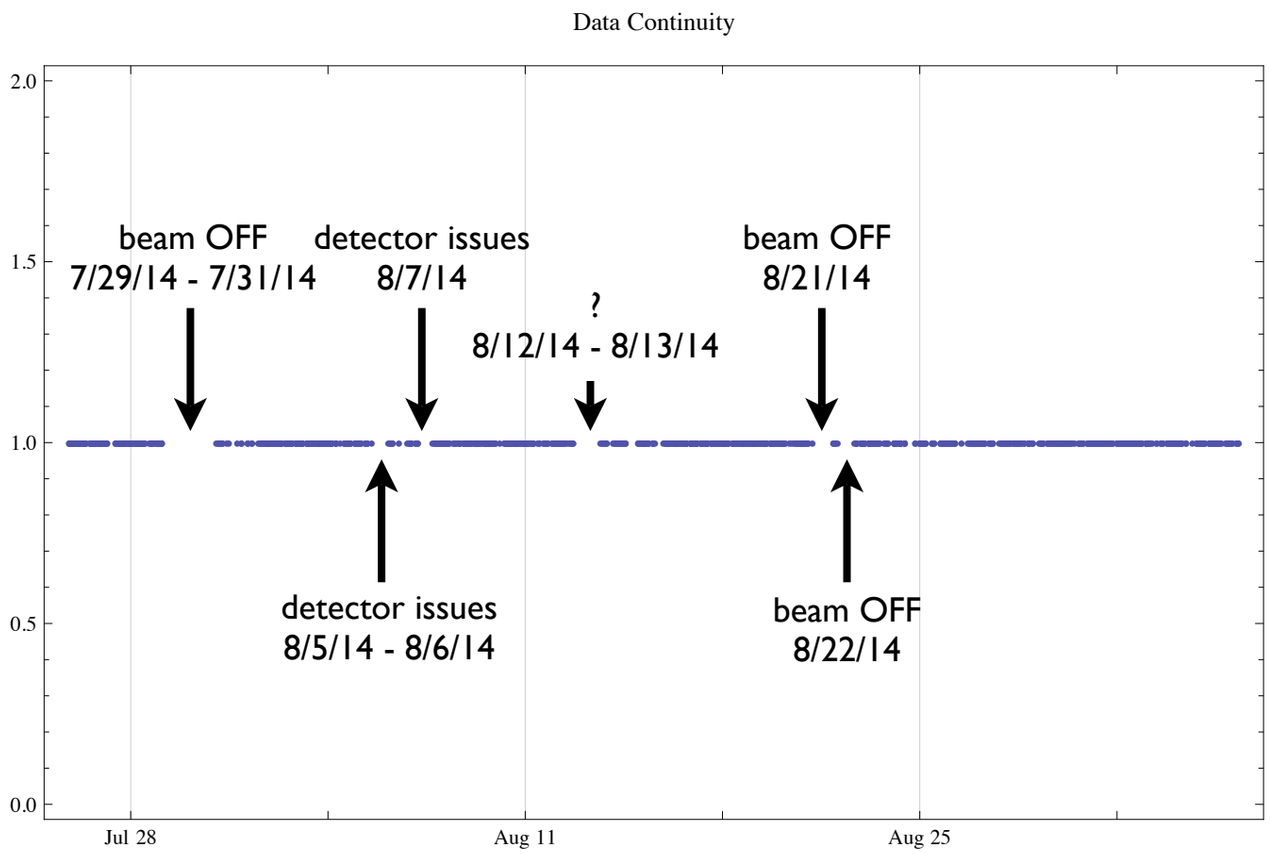
  Beam parameters quantifying horizontal and vertical position, respectively, used to make beam quality cuts, calculated using measurements coming from the beam position monitors.

- widthx and widthy (0.57 mm < width x(y) < 1.58 mm)

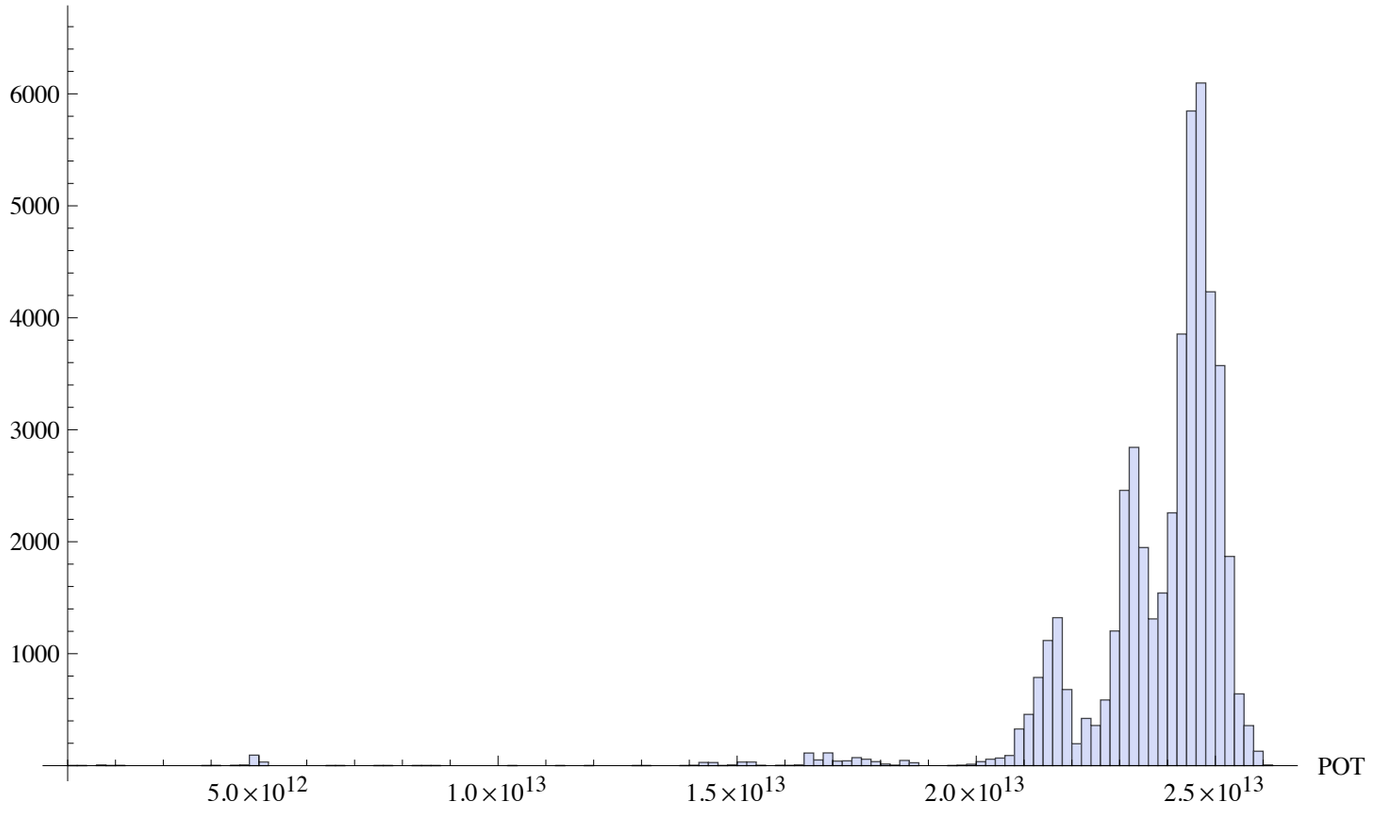
  Beam parameters quantifying horizontal and vertical spread, respectively, used to make beam quality cuts. These are determined by fitting a Gaussian to the beam profile data.

Beam Quality Parameters - Data Set

- Used CAF files from NuMI stream for July 25, 2013 through September 5, 2014
- Used subruns 0 and 1 from each run sequence to sample data every hour or so and to get reasonable statistics
- Processed 878 runs with ~51,000 spills. Of these, 61 runs had no POT at all in them; these runs were not used in the analysis. 817 runs with 49261 spills were analyzed for this study.

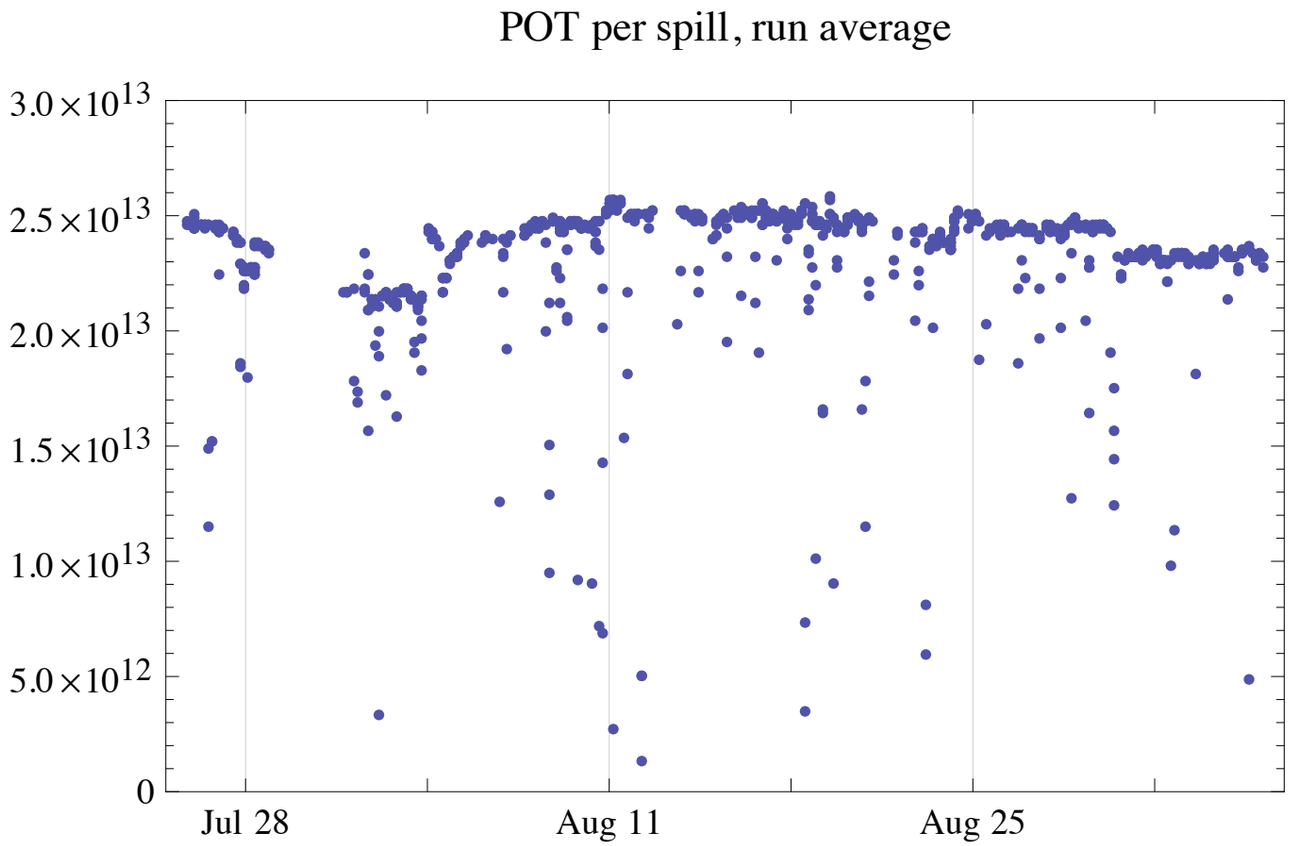


POT

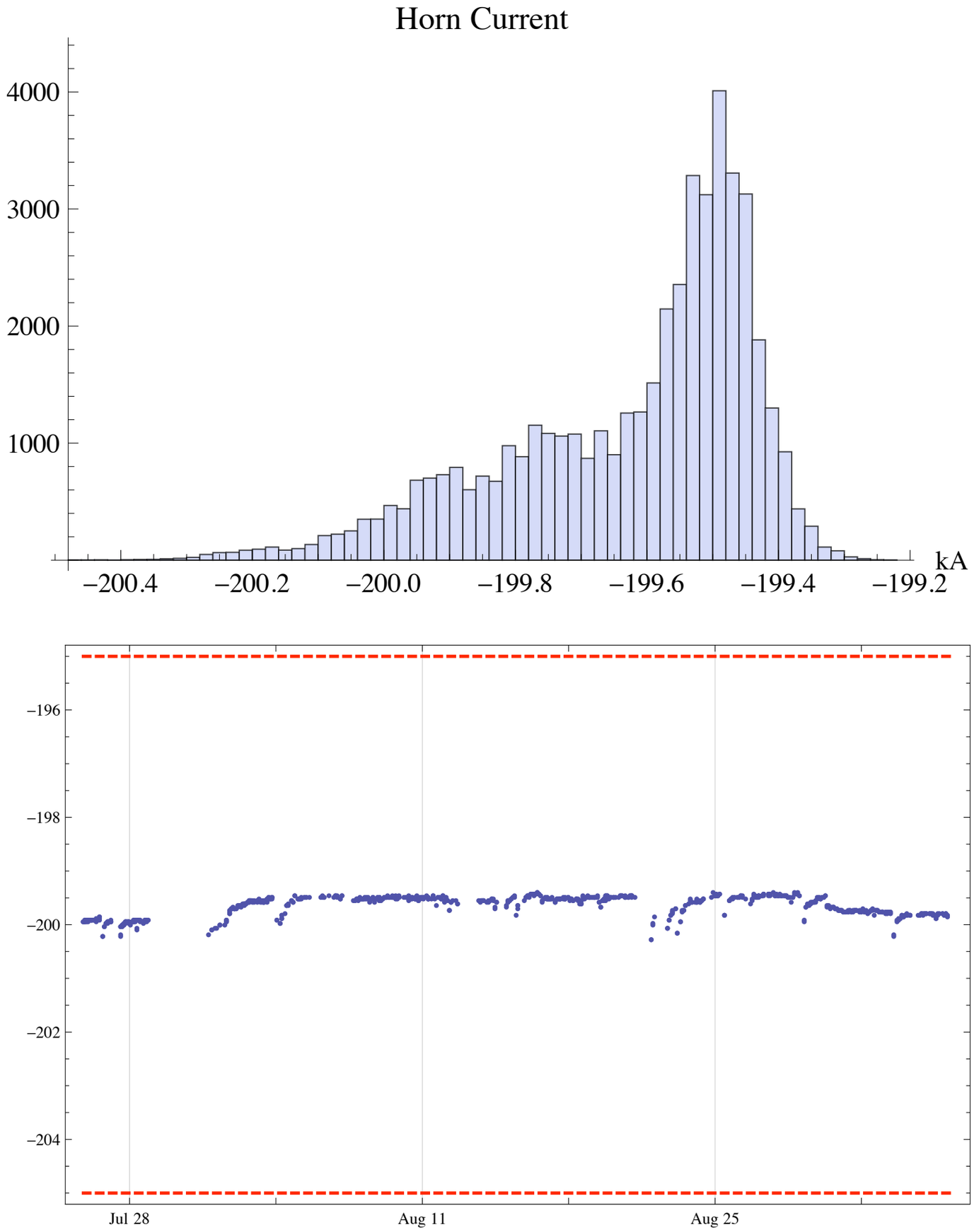


1606 spills failed cuts
(all had no POT)

3.26% of all spills



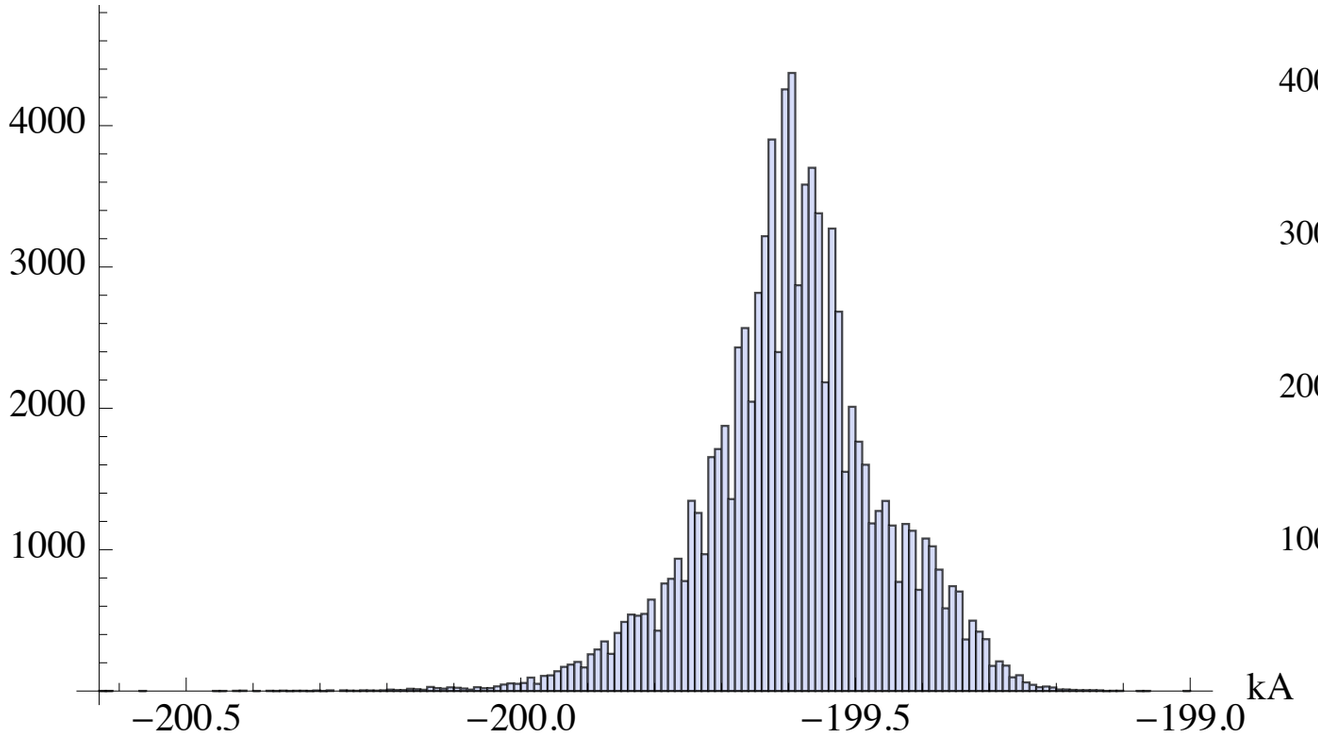
Horn Current



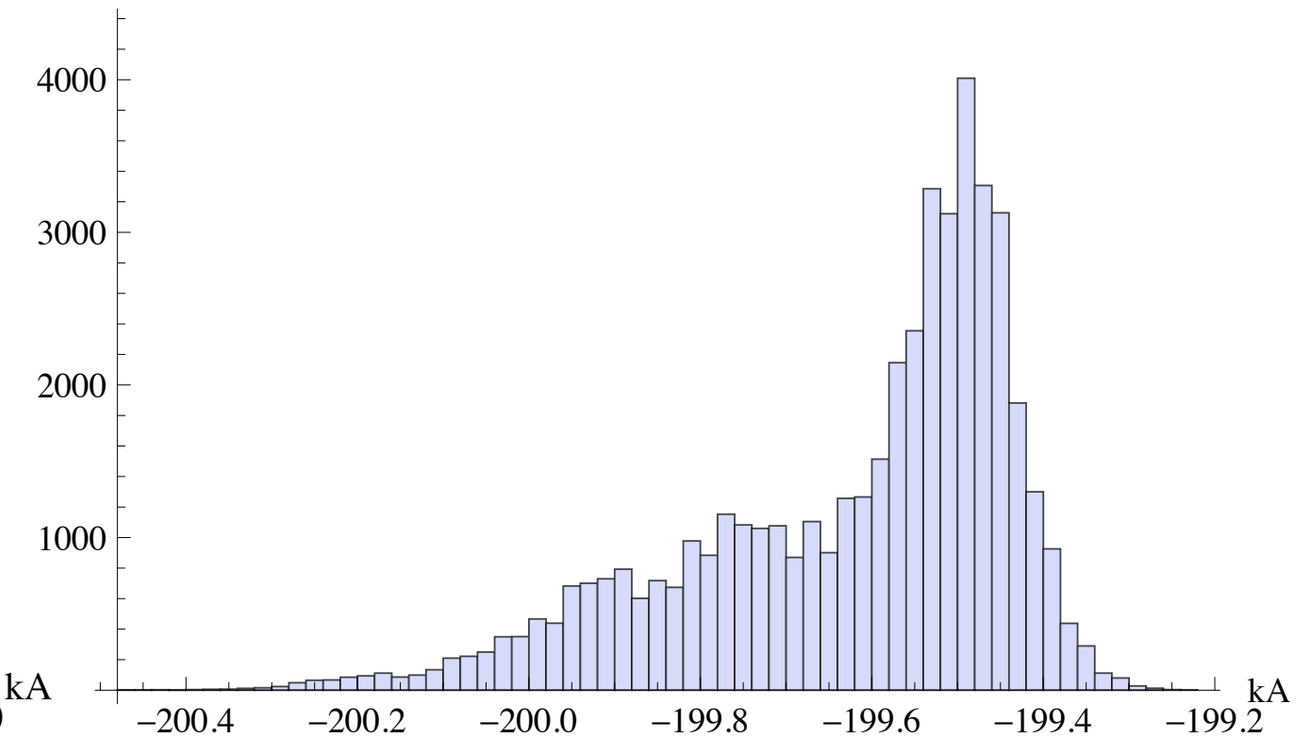
no spills with non-zero POT failed horn current cuts

Horn Current Comparison

October 2013-April 2014

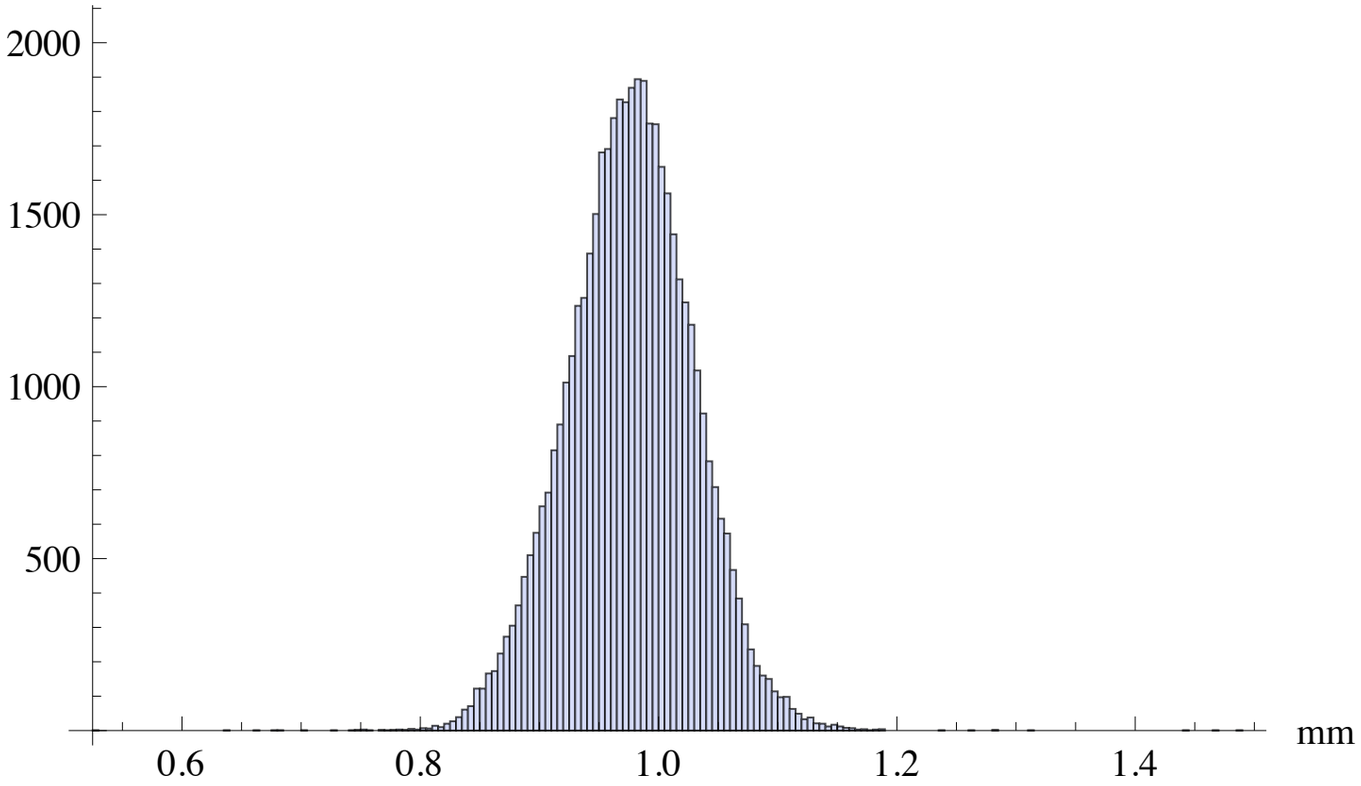


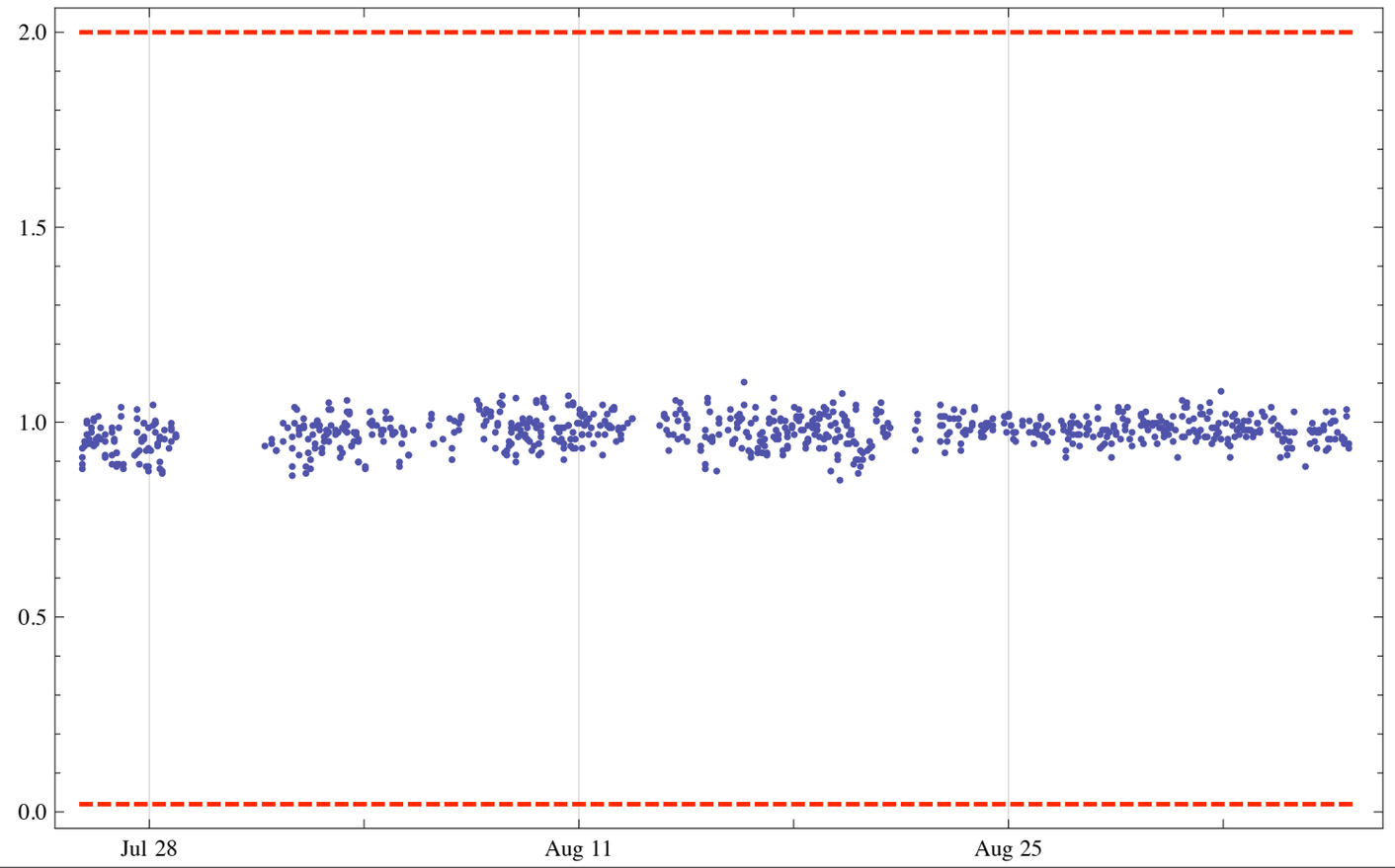
July 2014 - September 2014



This distribution is less symmetric for Summer 2014 data than for the data from Fall 2013 through Spring 2014.

Beam Horizontal Position at the Target

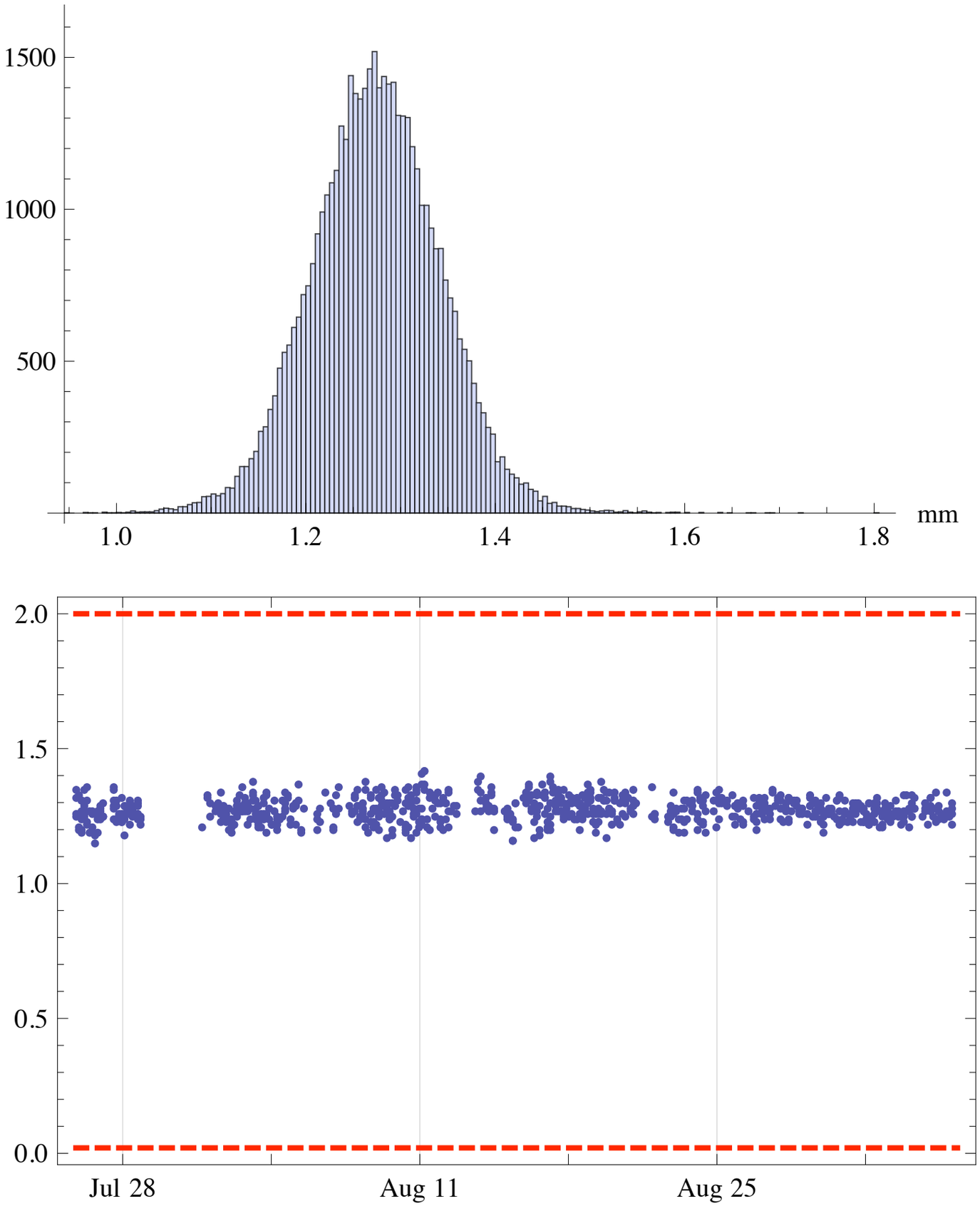




4 spills failed cuts
(passed POT cut)

0.0081% of all spills

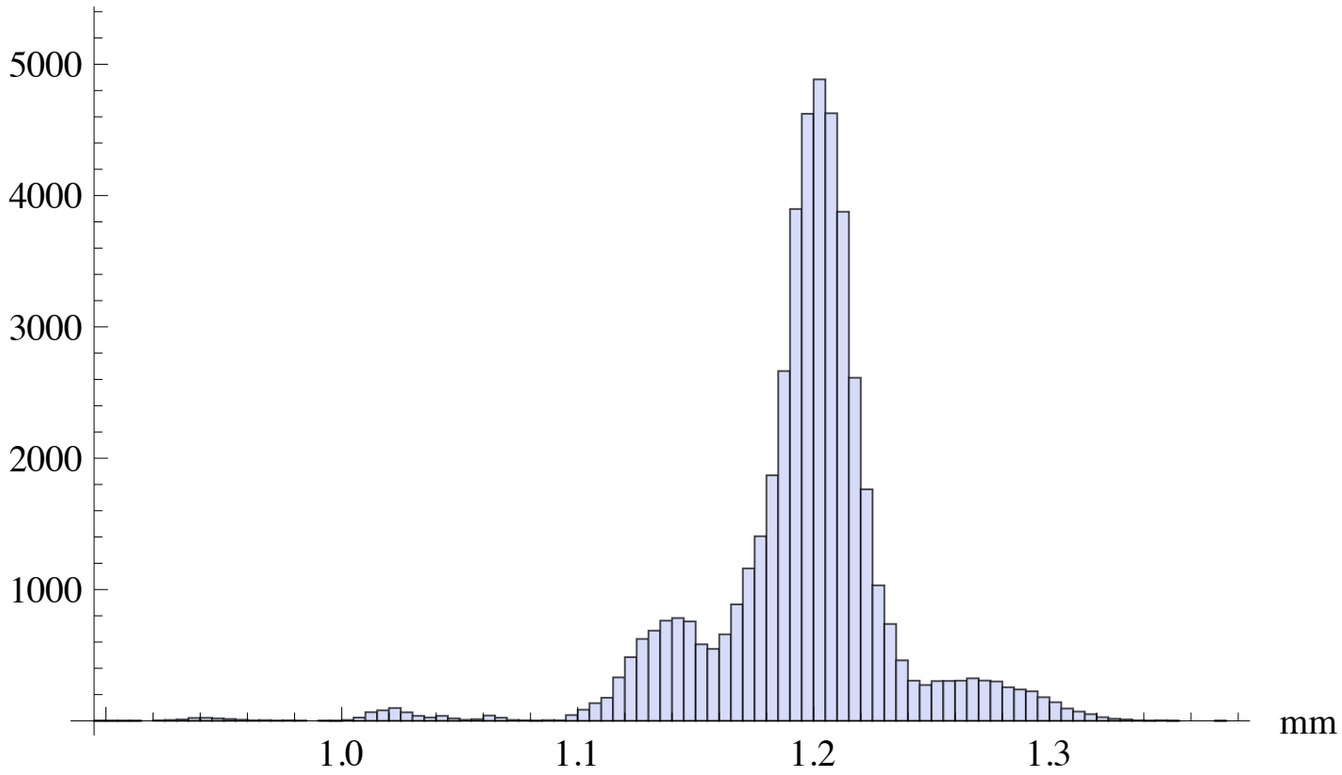
Beam Vertical Position at the Target

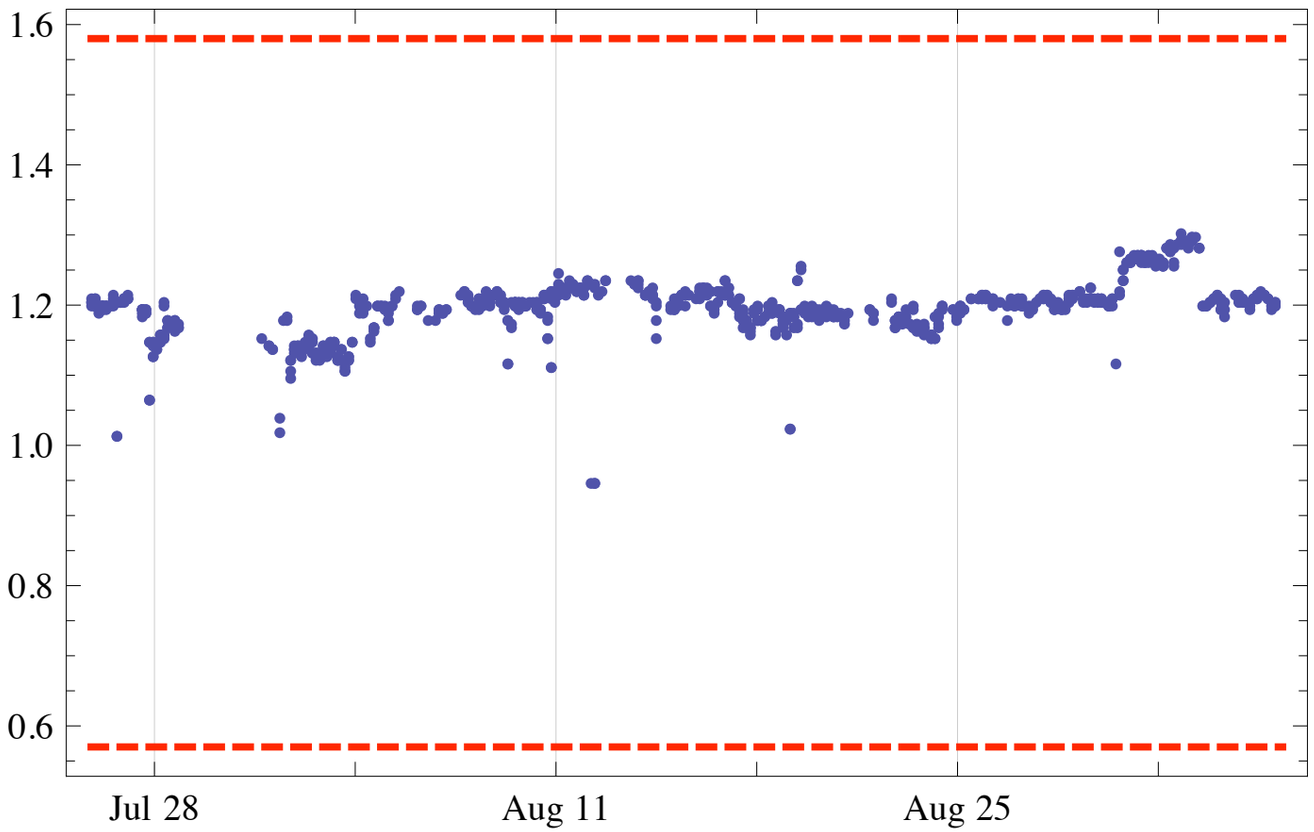


3 spills failed cuts
(passed POT cut)

0.0061% of all spills

Beam Horizontal Width at the Target

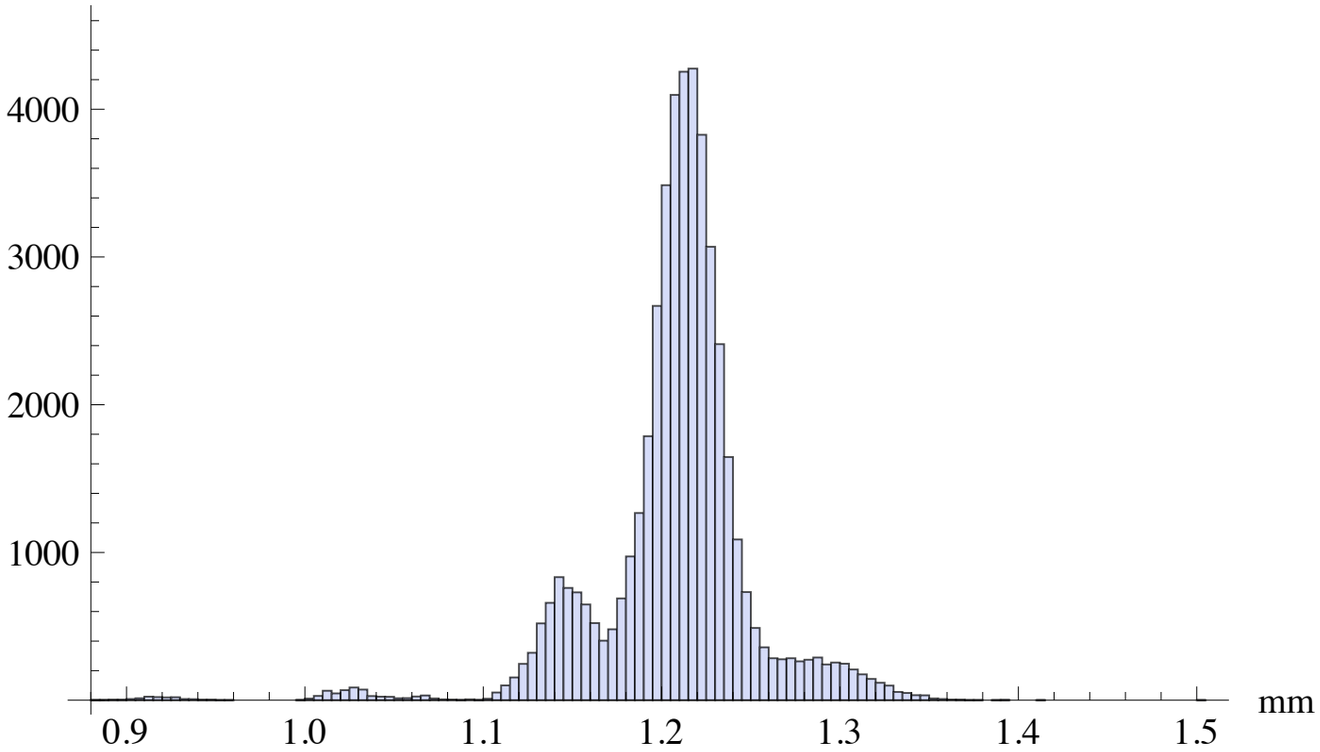


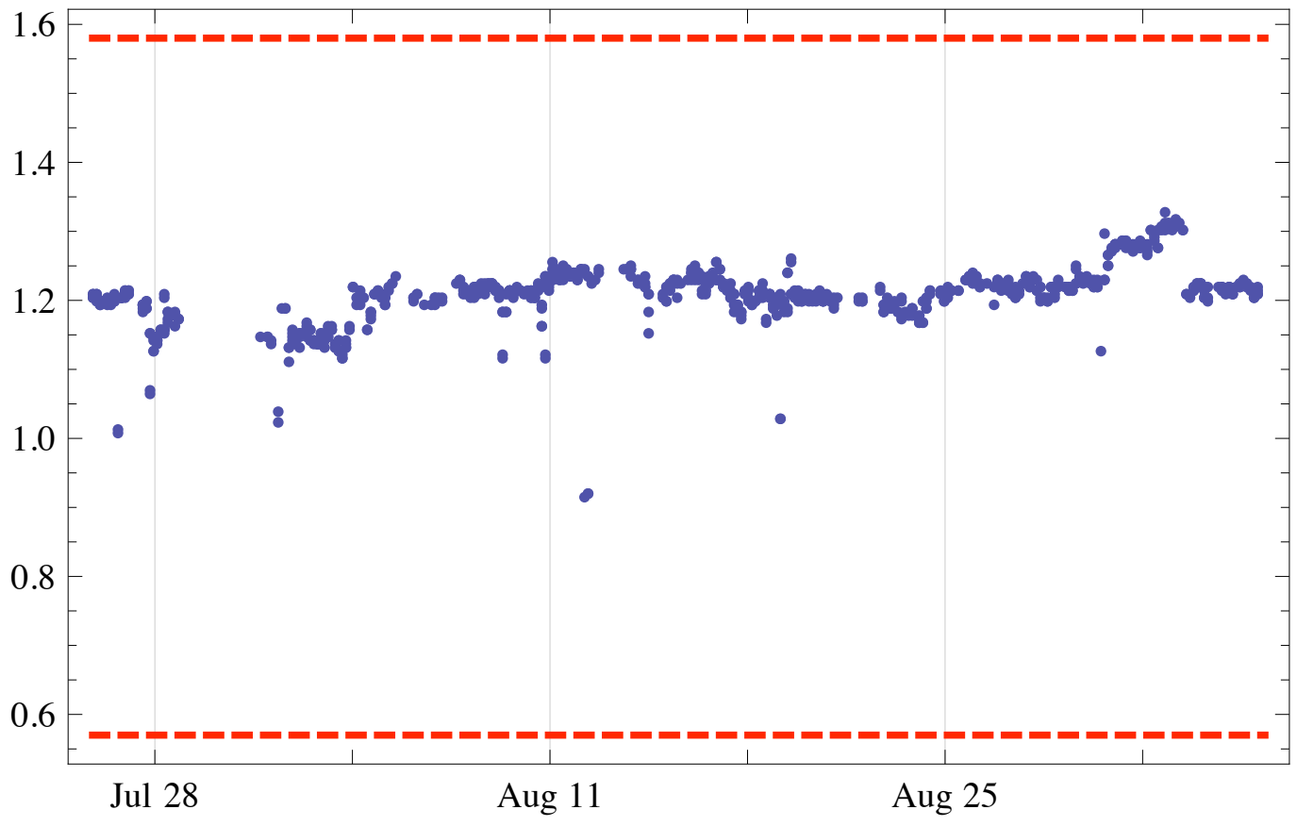


8 spills failed cuts
(passed POT cut)

0.0157% of all spills

Beam Vertical Width at the Target

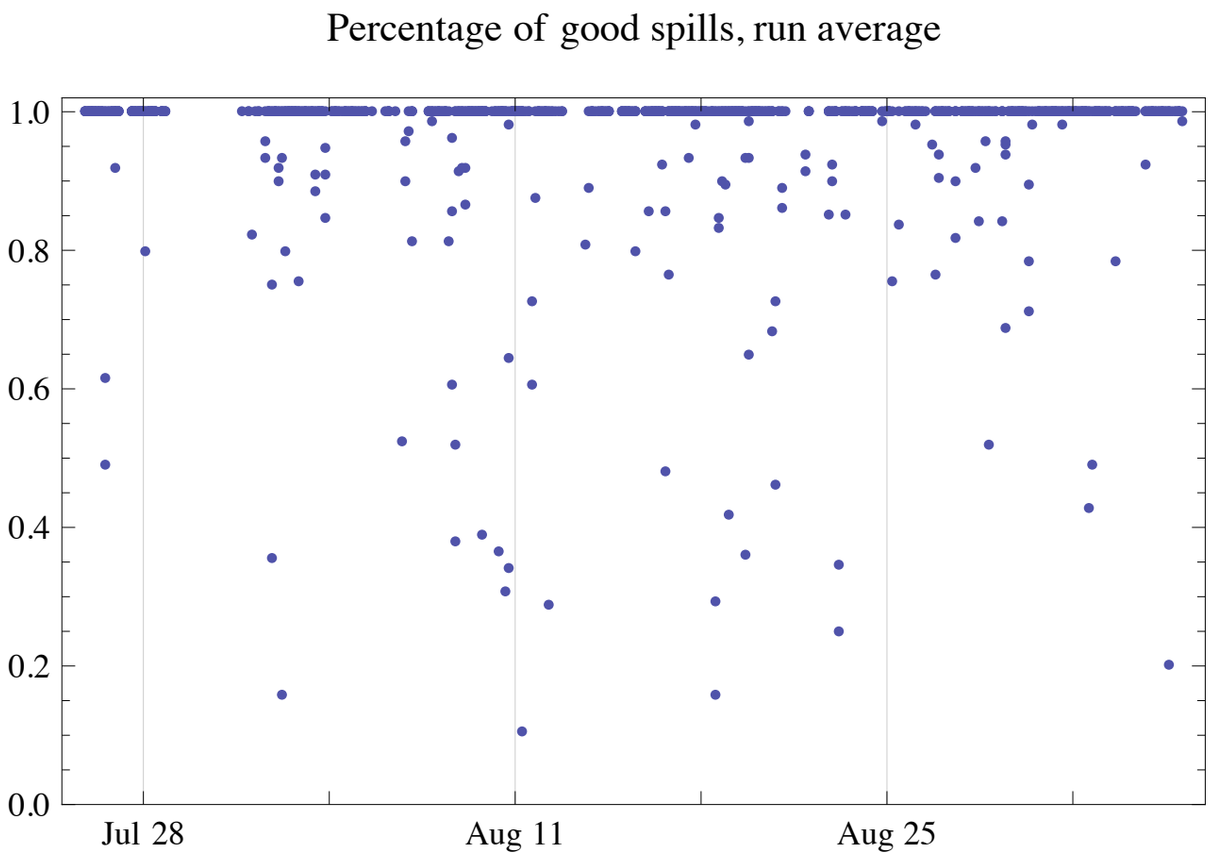




9 spills failed cuts
(passed POT cut)

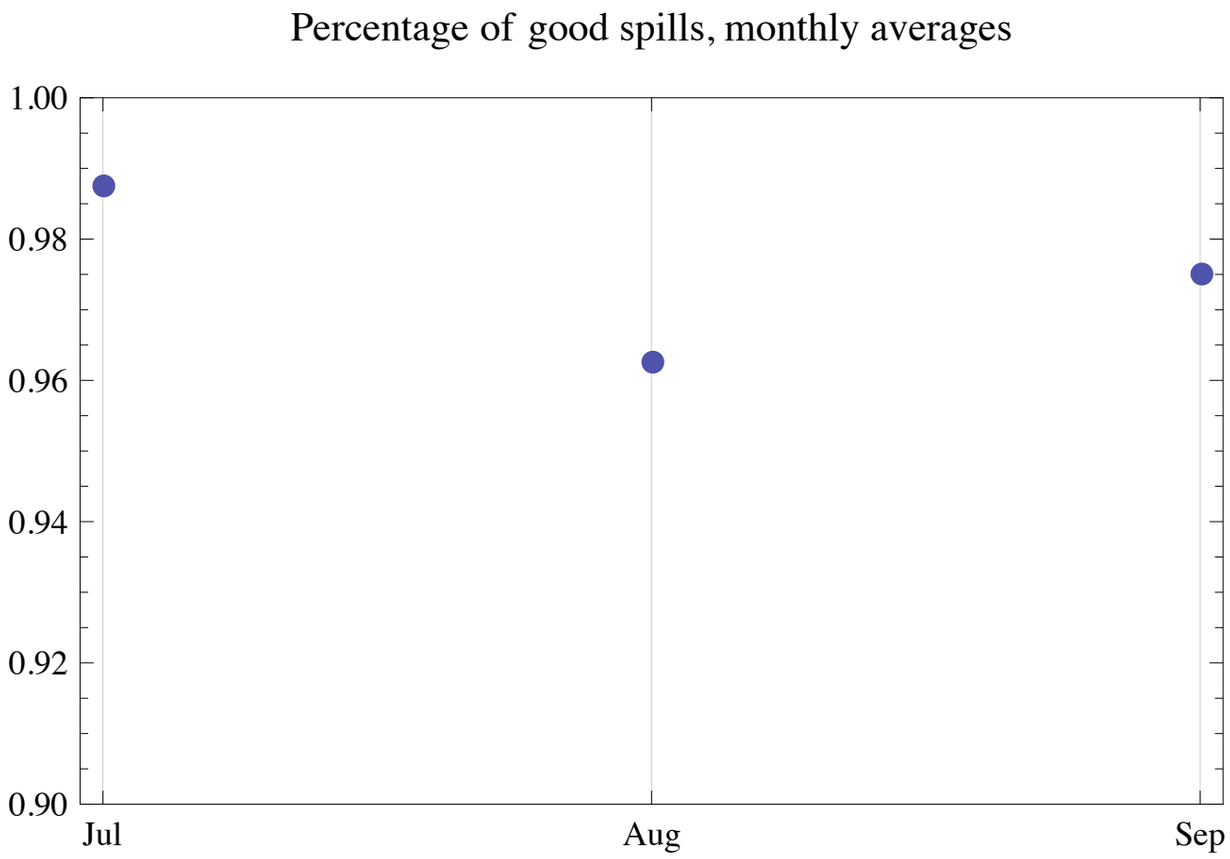
0.0177% of all spills

Good Spills



1618 bad spills

3.286% of all spills



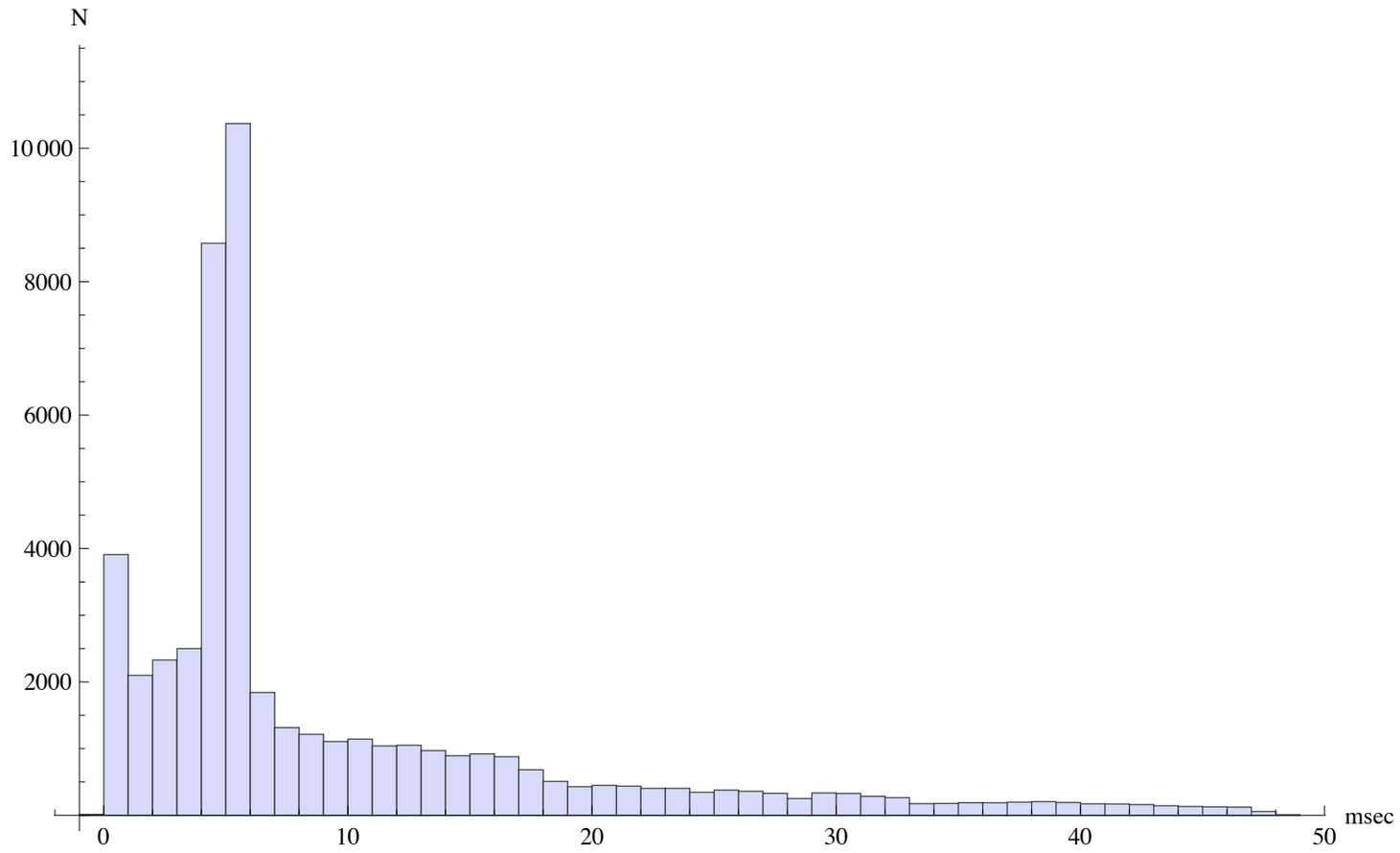
Summary

49241 total spills

Parameter	# Bad Spills	% of Total
POT	1606	3.26%
Horn Current	0	0%
x Position	4	0.008%
y Position	3	0.006%
x Width	8	0.016%
y Width	9	0.018%
Good spill	1618*	3.29%*

* total is not the sum of the individual parameters because there is some overlap in the bad spills for those parameters other than POT, eg. some spills that don't pass the x position cuts also don't pass the y position cuts

Proposal to change Delta t cut

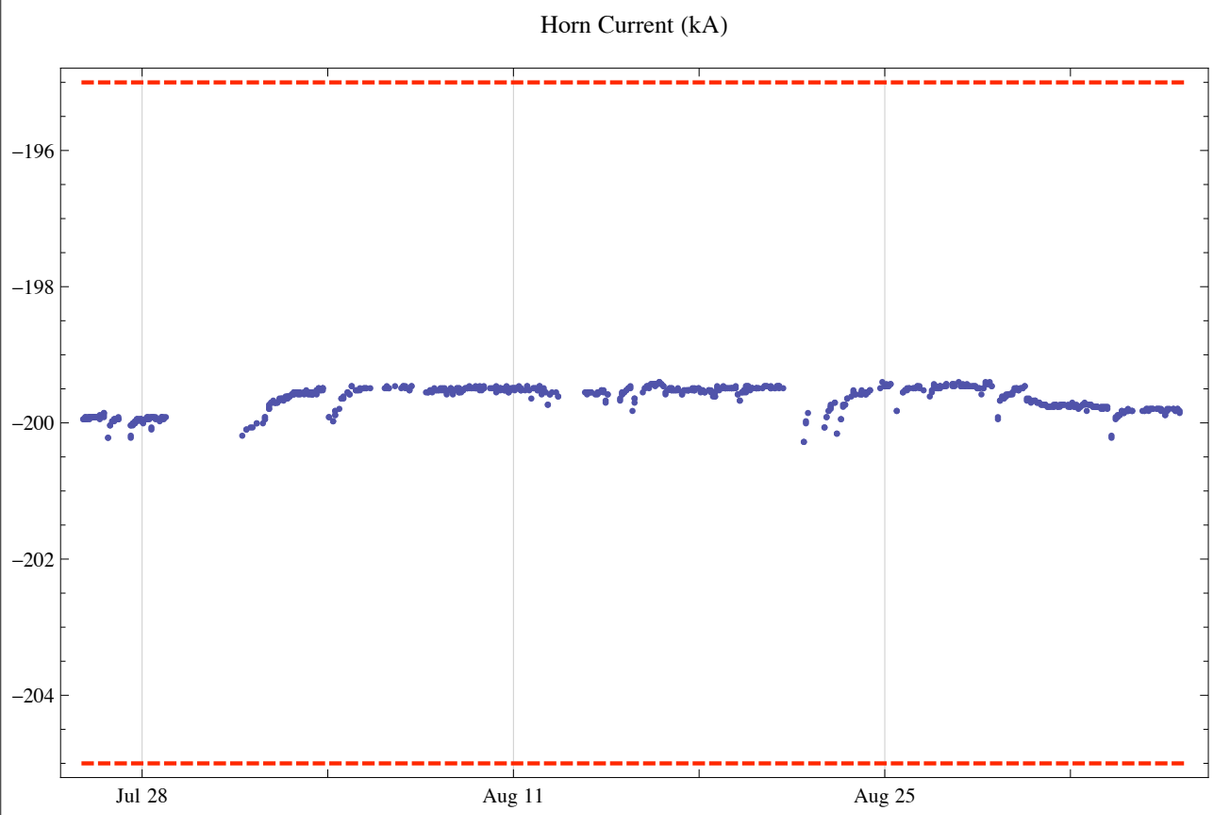


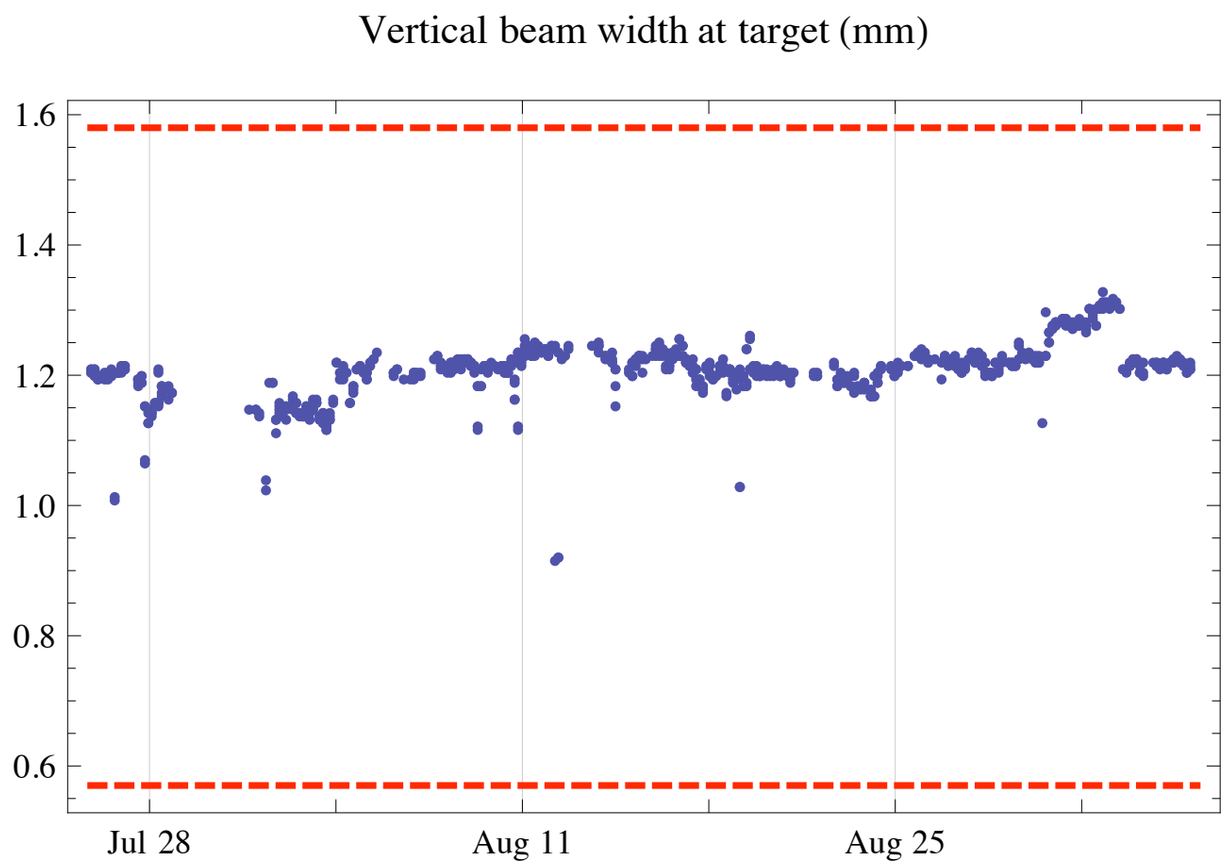
Delta t cut is currently set at $\Delta t < 1 \times 10^9$ ns, which was based on the value used in MINOS. No spills failed this cut, and in fact all spills in this data sample have a value less than 50 ms. I have found this to be true in general for good spills.

I propose changing this cut value to 50 ms.

Plans for Nearline

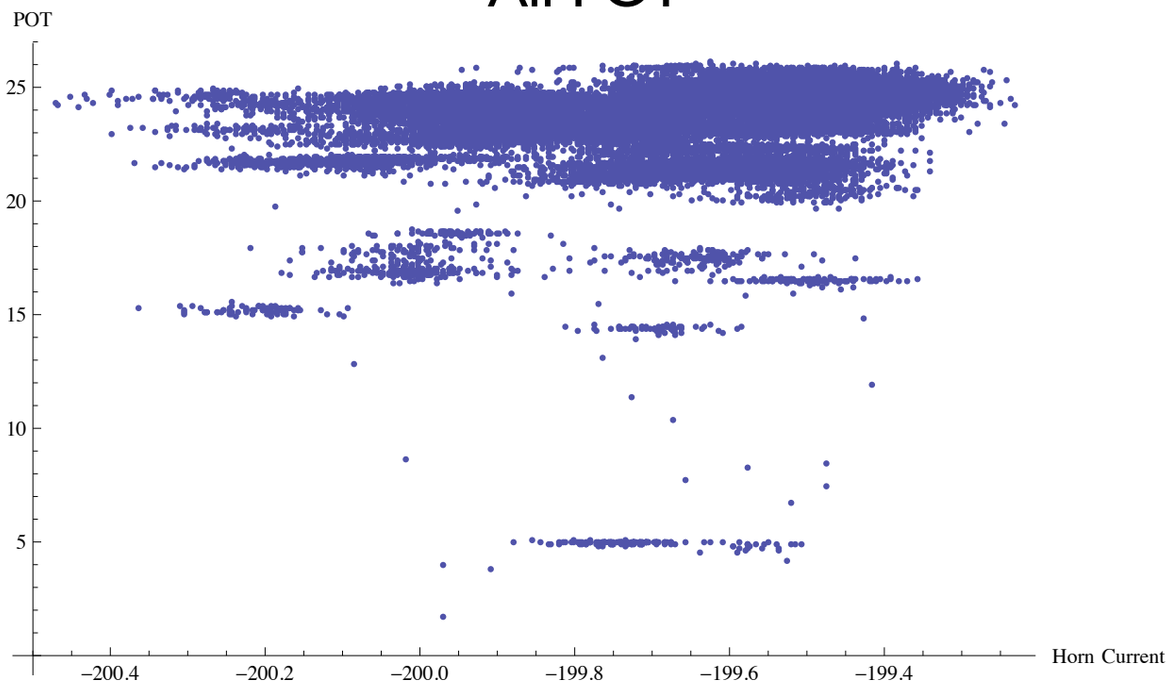
Over the next month, I am going to implement a beam quality section into the Nearline. Plots will be similar to those in this talk showing parameters as a function of time along with the cut values (see two examples below), but will be "ROOT-ified". Suggestions for other useful plots are welcome.



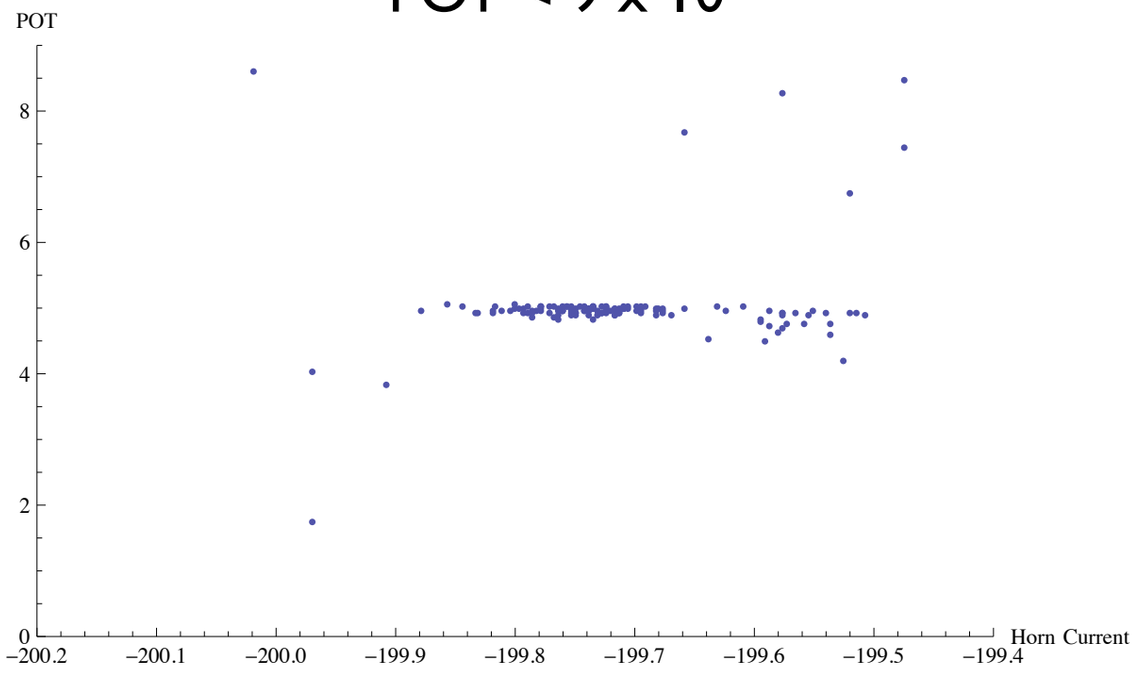


POT versus Horn Current

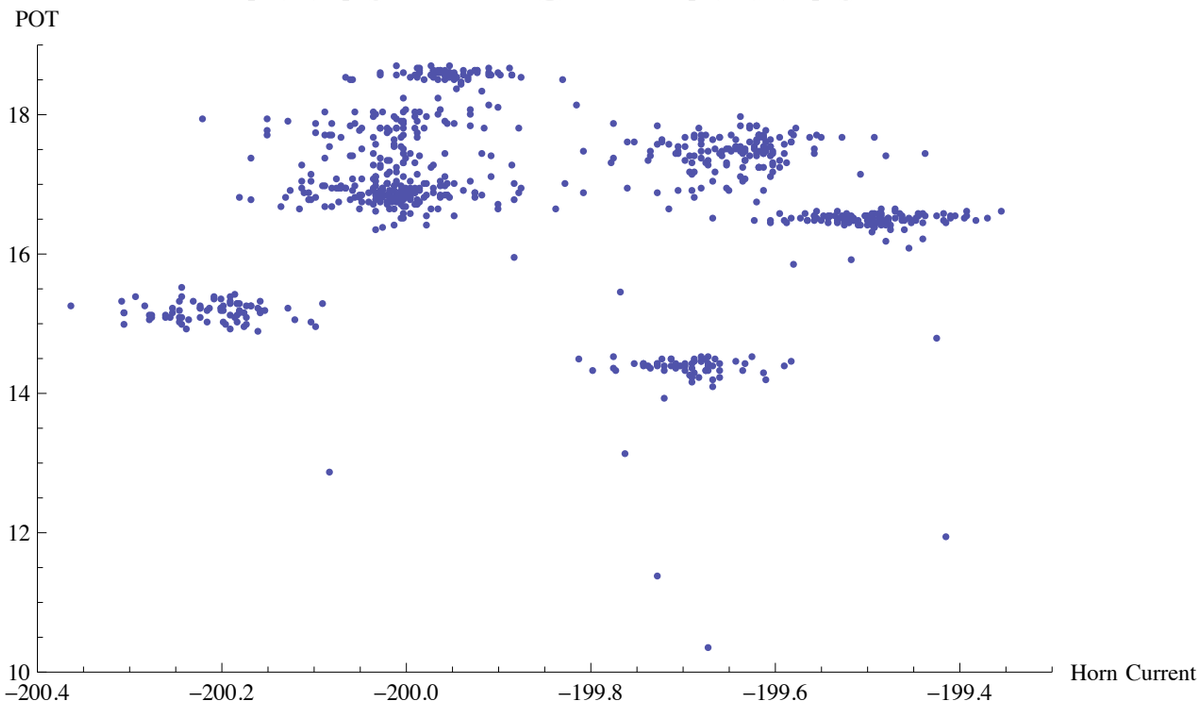
All POT



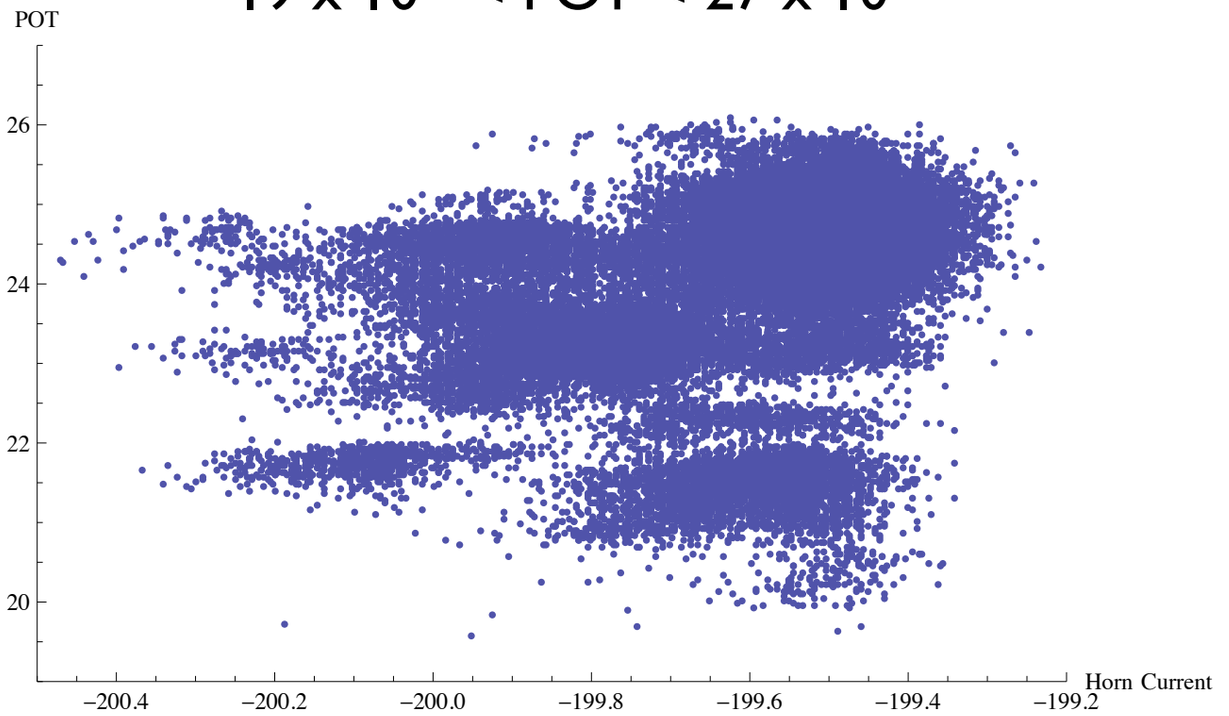
POT < 9 x 10^{12}



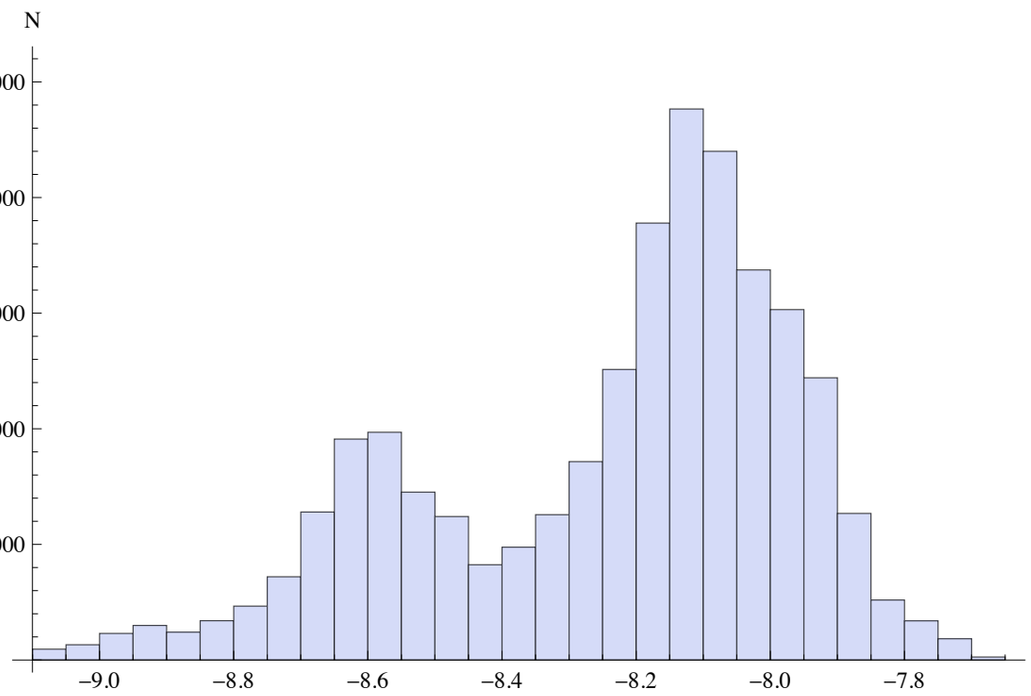
1 x 10^{12} < POT < 19 x 10^{12}

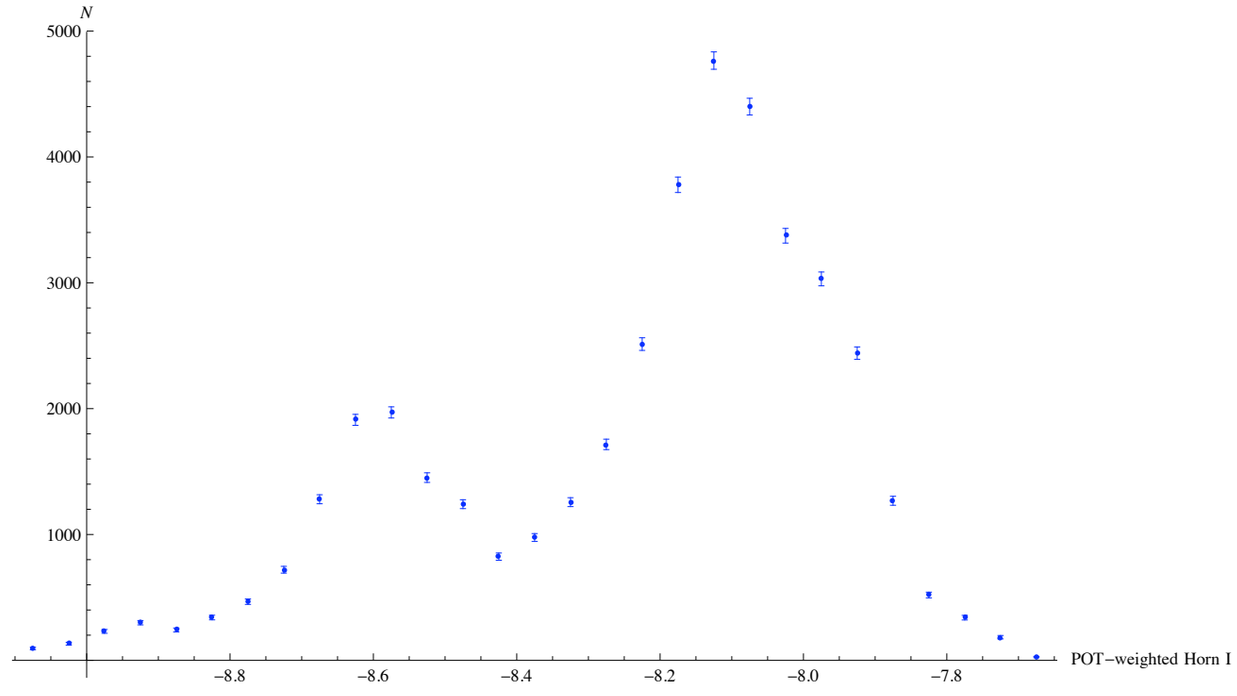


19 x 10^{12} < POT < 27 x 10^{12}



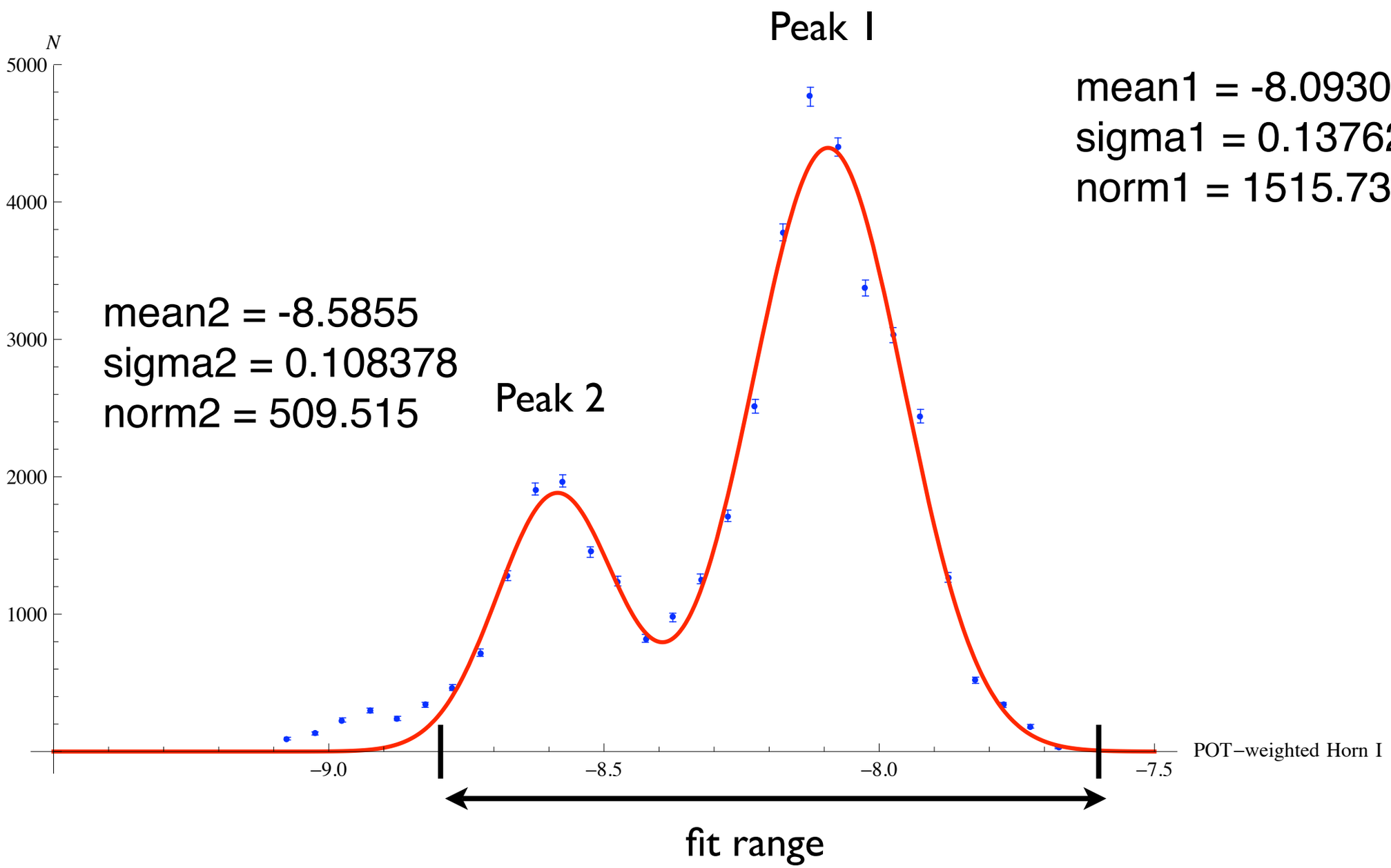
Distribution of POT-weighted Horn Current





The distribution is tri-modal in the region where most of the spills are located. There are additional, smaller peaks (maximum values ~100 entries) at lower values.

Distribution of POT-weighted Horn Current



I fit the largest two peaks to two separate Gaussians for values in the range -8.8 to -7.6.